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A DICOTYLEDONOUS WOOD FOUND ASSOCIATED WITH THE IDAHO TEMPSKYAS

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In a recent number of this journal, a series of new interpretations and a summary of our knowledge of the fossil fern *Tempskya* were presented by Andrews and Kern ('47). As a part of their contribution, they described the other plant remains that had been found associated with *Tempskya* in the Cretaceous beds of Idaho. Representatives of the Bennettitales and of the Coniferales were described, and mention was made of a dicotyledonous wood that occurred with these fossils at the Wayan, Idaho, site. This dicotyledonous wood will be described in the present paper in the hope that it will add something to our meager knowledge of the type of plant that lived with, or in the vicinity of, these most peculiar fossil ferns.

The wood specimen was collected near Wayan, Idaho, the site being just east of the Wayan post-office. The source rock is the Wayan Formation which is listed by Wilmarth ('38) as Upper Cretaceous on the basis of the work of Read and Brown ('37). Lower Cretaceous age is also suggested by Wilmarth, and thus it is apparently not possible at the present time to put the formation in its proper place in the Cretaceous without a feeling of uncertainty. The wood is silicified, or partially so, but as can be seen from the photographs, sufficient structure has been preserved so that it is not difficult to make out most of the important features. The thin sections were prepared in the laboratory of Dr. H. N. Andrews and sent to the author for identification. The slides from which the description has been made are Nos. 1482, 1483, and 1484, of the Henry Shaw School of Botany Collections, Washington University, St. Louis.

After considerable study of these slides and of the woods with similar structure to be found in the Harvard Wood Collection, it became evident that, on the basis of the available comparative material, it would be impossible to assign this fossil wood to any living genus or species. At this point Professor I. W. Bailey suggested that this fossil wood appeared to be similar to a wood he described from the Upper Cretaceous (Colorado Group) of Arizona. A portion of the type specimen of this Arizona fossil was obtained from the U. S. National Museum through the courtesy of Dr. Roland W. Brown and thin sections were prepared from this specimen. *Paraphyllanthoxylon arizonense* Bailey was then compared with the Idaho dicotyledonous wood.

The structure of these two woods is remarkably similar, and, while it must be admitted at the outset that they are not identical, it would be extremely difficult to justify the assignment of this new wood to a genus other than *Paraphyllanthoxylon*. The Idaho wood differs from *Paraphyllanthoxylon arizonense* Bailey in several of its characters but none of these fall outside of the limits set by Professor Bailey in his definition of this form-genus (Bailey, '24).[1] The vessels in the Arizona fossil are fewer in number and larger in cross-section, and the intervascular pitting is inclined to be more abundant, approaching at times a hexagonal pattern. Further, the rays in *P. arizonense* are wider and higher, and the individual cells are more radially elongate. The magnitude and the nature of these variations are well within the range of variability found in individuals of many living species, and thus the differences in the two fossils might be accounted for on the basis of the part of the tree from which the specimen was derived, differences in growth rate, etc. In spite of this, however, it seems appropriate, because of these differences, to describe this new wood as a new species with the hope that the true relationship of these two fossils will be demonstrated in the future as the result of an increasing understanding of fossil woods.

The Idaho fossil wood may be described as follows:[2]

Paraphyllanthoxylon idahoense sp. nov.

Growth Rings:

While it was at first thought that there was some reason to believe that growth rings might be present (fig. 7) it now seems clear that the one isolated area in question is simply a patch of radially narrow septate fibers such as often occur in a number of woods (e. g., *Mespilodaphne sassafras* Meissn.—Lauraceae).

Vessels:

Average diameter: 100 μ; range 60–160 μ. *Average length:* approximately 500 μ. *Arrangement:* wood diffuse, porous; vessels solitary and in short multiples of 2 or 3, occasionally clusters of 3 or 4 (figs. 1 and 2). *Perforation plates:* exclusively simple; angle of end wall oblique to transverse (fig. 6). *Intervascular pitting:* alternate, abundant, circular to elliptical, rather large, i. e. 10–12 μ; orifice slit-like (fig. 6). *Vessel-parenchyma*

[1] Professor Bailey states that the genus was created "for the reception of dicotyledonous woods having combinations of anatomical characters such as occur in mature stems of *Phyllanthus emblica* L., and other structurally similar representatives of the Phyllanthoideae."

[2] The features used are those suggested by Tippo ('41), and the terms are used as defined by the Committee on Nomenclature, International Association of Wood Anatomists ('33).

pitting: elongate-oval (as in the Flacourtiaceae), at least in part (particularly on the erect ray cells). *Tyloses:* abundant, multiple; tightly packed in all, or nearly all, vessels; not sclerotic (fig. 4).

Xylem Parenchyma:

Very sparsely paratracheal (vasicentric). Crystal-bearing strands diffuse *if present.* Although some areas suggest the presence of crystal-bearing parenchyma strands (fig. 4) this could not be conclusively demonstrated. These structures may indicate resiniferous septate fibers or may simply be a product of the degradation of the cell wall.

Xylem Rays:

Abundant; mostly multiseriates. Cells partially filled with some ergastic material (probably phenolic compounds). Multiseriate rays 2–4 cells wide, most of the cells being procumbent with the marginal cells usually erect (fig. 3). Uniseriate rays usually contain a mixture of erect and procumbent cells (fig. 3). Structures suggesting the presence of crystals are occasionally observed.

Fibers:

Septate fiber-tracheids throughout (fig. 5).

Assuming the septate fibers, abundant tyloses, and the nature of the perforation plate to be constant features in the older secondary xylem of the fossil species, the number of families to which it could be related is comparatively few. Study of the woods of the families thus selected revealed a number of genera that contained species closely similar to the fossil, none of which, however, were identical. The similarities and differences between the fossil and these living species are summarized in Table I. Only one species of each genus is listed although in the case of *Canarium* and *Beilschmiedia* there are other species that are equally similar.

Of the six families included in the table, the fossil finds its best counterparts in the Anacardiaceae, Burseraceae, and the Euphorbiaceae. The absence of radial gum ducts in the fossil, however, reduces the possibility of it being either a *Koordersiodendron* or a *Garuga,* although in most other features the similarities are quite striking. It is, of course, possible that the fossil had gum ducts and, by chance, none are contained in the specimen studied. This possibility should certainly be recognized, but it is obvious that it is impossible to go beyond this point and still justify one's methodology.

Bridelia minutifolia Hook. (Euphorbiaceae) possesses a number of features in common with the fossil, and its ray type may not be too dissimilar to be an ontogenetic phase of the fossil ray type. The same applies to *Phyllanthus emblica* L., but in both cases it is evident that the living wood is by no means identical with that of the fossil. The Lauraceous forms are quite similar but the inflated secretory cells in the rays eliminate these from our consideration. *Kirkia acuminata* Oliver (Simarubaceae) may be rejected because of its ray type, and while the rays of

TABLE I

A COMPARISON OF THE FOSSIL WOOD WITH SIMILAR LIVING SPECIES

Possible Relative	Vessels					Fibers	Xylem parenchyma	Xylem rays	Other Features
	Approximate length (microns)	Form and arrangement	Perforation plate	Intervascular pitting	Vessel-ray pitting				
ANACARDIACEAE									
Koordersiodendron pinnatum Merr.	480	X[1]	X	X	X	X	X[2]	—[3]	Radial gum ducts present; ergastic material in the rays and fibers very similar to that of the fossil
Schinopsis balansea Engl.	300	—	X	X	X	X[4]	—	—	Radial gum ducts present
Mauria simplicifolia DC.	300	—	X	X	X	X[4]	X	—	Abundant strands of crystal-bearing parenchyma present
BURSERACEAE									
Garuga pinnata Roxb.	310	—	X	X	X	X	X	X	Radial gum ducts present
Canarium rufum Benn.	330	—	X	X	X	X	X	—	Radial gum ducts present
EUPHORBIACEAE									
Phyllanthus emblica L.	480	—	X	X	X	X	X	—	Tyloses in vessels infrequent
Bischofia javanica Blume	420	X	X	X	X	—[5]	X	—	Walls of ray cells "beaded"
Bridelia minutifolia Hook.	480	X	X	X	X	X	X	—	Tyloses in vessels infrequent; strands of crystal-bearing parenchyma present
LAURACEAE									
Beilschmiedia roxburghiana Nees	410	—	X[6]	X	X	X	X[2]	—	Secretory cells present
Mespilodaphne sassafras Meissn.	360	X	X	X	X	X	X[2]	—	Secretory cells present
SIMARUBACEAE									
Kirkia acuminata Oliver	350	X	X	X	X	X	X	—	
VERBENACEAE									
Petitia domingensis Jacq.	320	—	X	X	X	X	X	X?	

[1] (X) signifies that structure is identical with fossil.
[2] Paratracheal parenchyma more abundant than in fossil.
[3] (—) signifies that structure differs from the fossil.
[4] Not all fibers are septate.
[5] Libriform septate fibers.
[6] Occasionally scalariform.

Petitia domingensis Jacq. (Verbenaceae) are more similar, the structure and arrangement of the vessels throw doubt on this form.

Some of the characteristics of the fossil can be found in families other than those listed above. For example, in the family Urticaceae the genera *Laportea* and *Pipturus* have abundant tyloses in the vessels, simple perforation plates, and the fibers are all septate. Numerous other features of the woods (storied cambium, wood parenchyma distribution, etc.) exclude the possibility of assigning the fossil to any of these families, and the inclusion of these and like forms in the table would have contributed nothing to our understanding of the fossil so they were omitted. It is clear, from the table and from these remarks, that this fossil has a combination of characters which can be similarly approximated in a number of dicotyledonous families. In view of this it appears unwise to suggest any specific family to which the fossil should be assigned, but it should be noted that the Anacardiaceae, Burseraceae, and the Euphorbiaceae represent the best possibilities.

All the species listed in the table are tropical or sub-tropical forms, but they represent both hemispheres and a variety of habitats. *Schinopsis* is found in swampy river bottoms, *Mauria* in highland areas; *Petitia* is confined to the West Indies, *Bischofia* to the Indo-Malayan region, etc. Little light, therefore, is thrown on the possible habitat of this cretaceous dicotyledon by the ecological and phytogeographical relations of the similar living species, although the implication is that it was not a temperate or cold temperate form. Hence, the identity, real affinity, and the greater part of the significance of this wood remain obscure, but the knowledge of the existence of a dicotyledon of this type among the remains of *Tempskya* is an interesting addition to our rather scant collection of facts regarding the associates of this extinct fern type.

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EXPLANATION OF PLATE

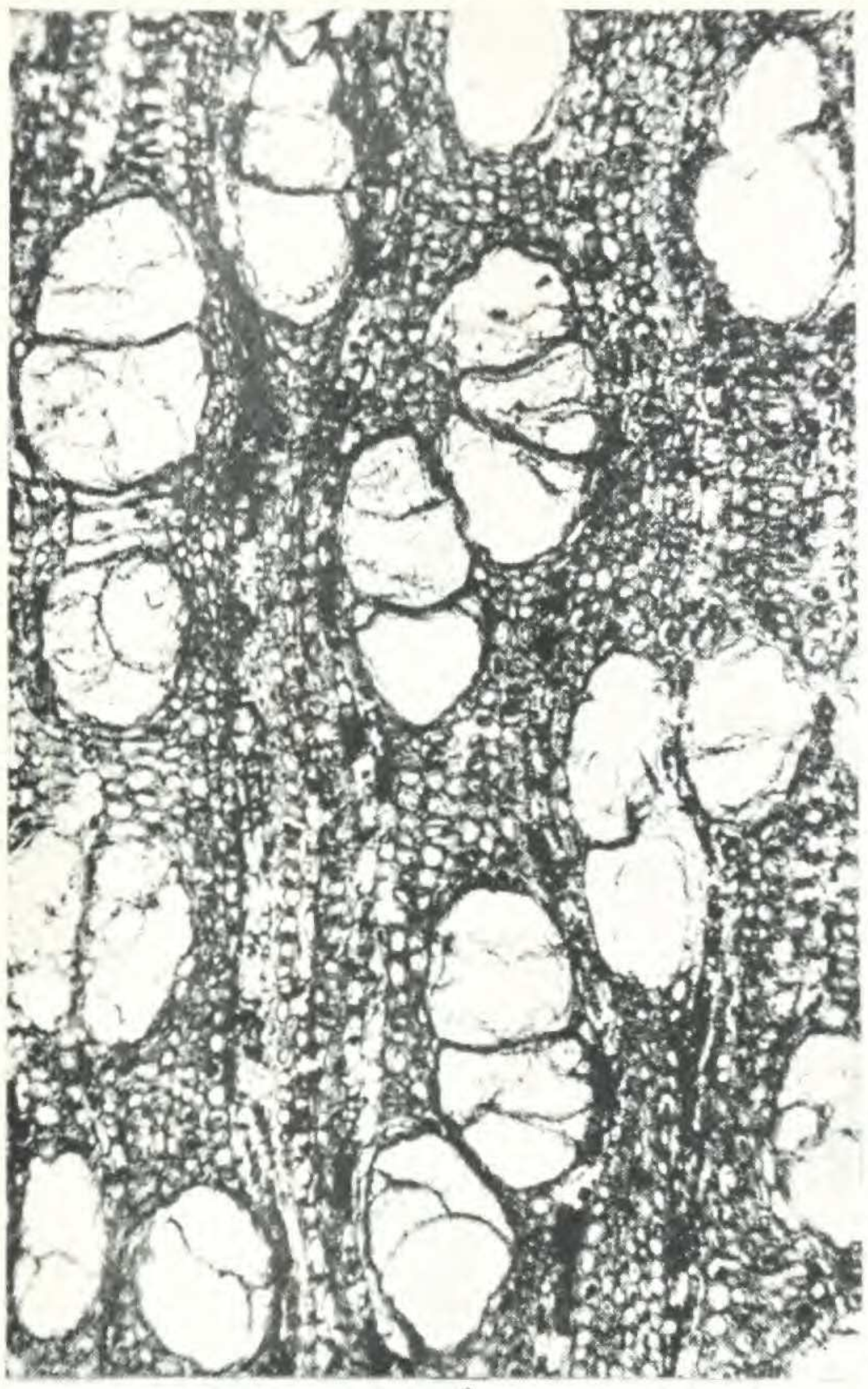
PLATE 1

Paraphyllanthoxylon idahoense

Figs. 1 and 2. Transverse sections showing the form and arrangement of the vessels and fibers. From slide No. 1482, × 100.

Fig. 3. Tangential section showing ray structure. From slide No. 1483, × 100.

Fig. 4. Radial section showing the abundant tyloses in the vessels and the questionable crystal-bearing parenchyma strands. From slide No. 1484, × 100.



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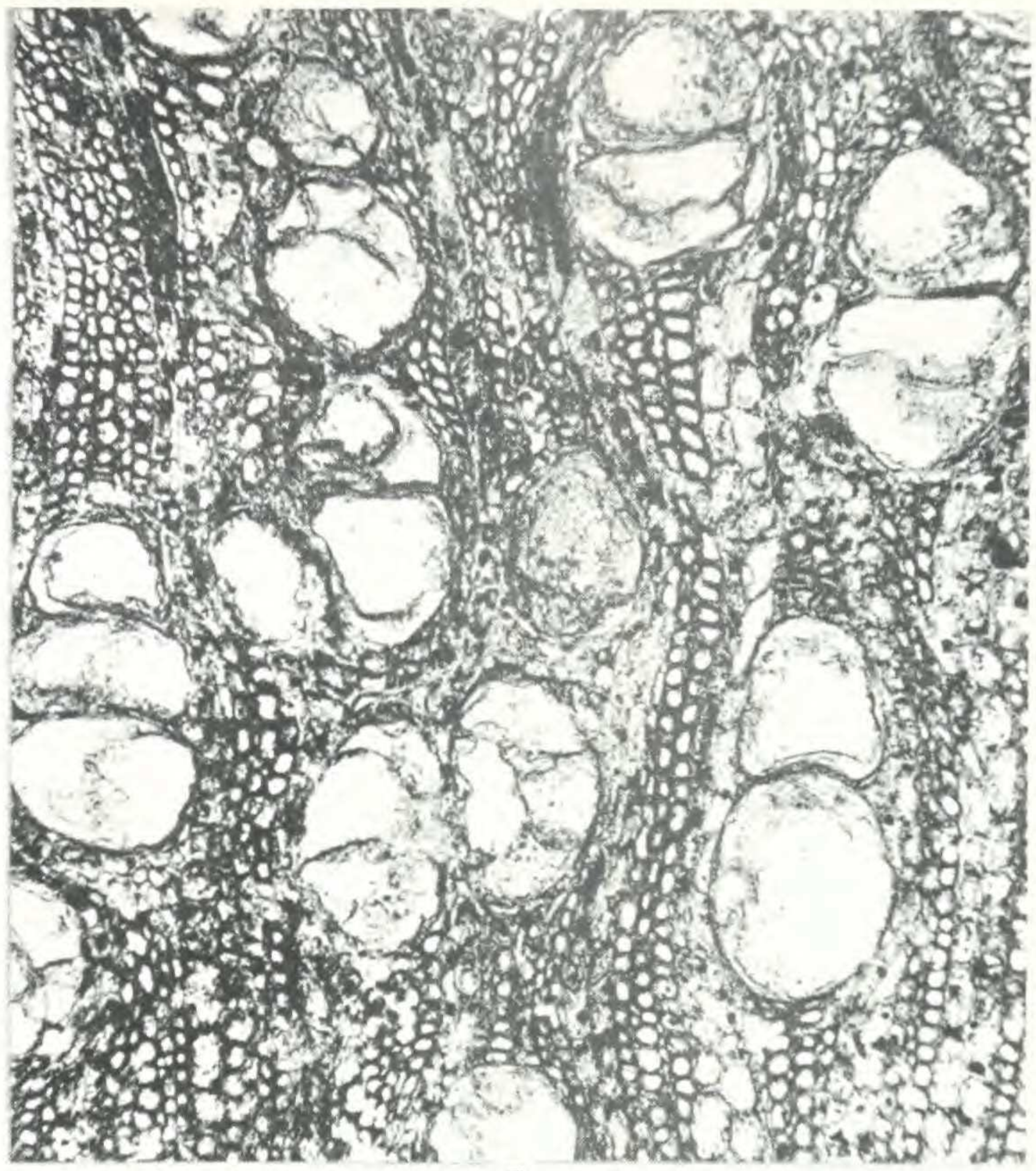

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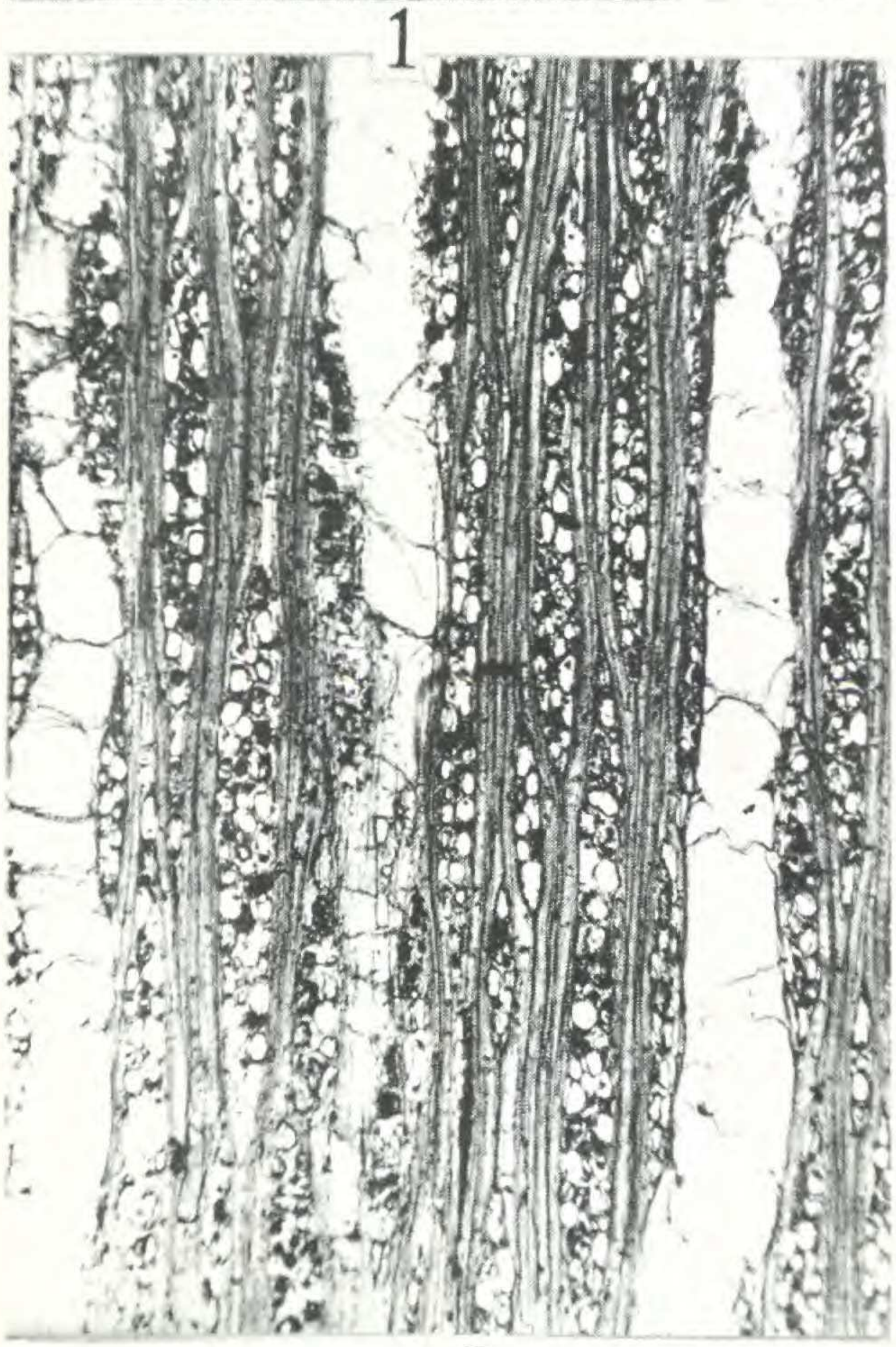

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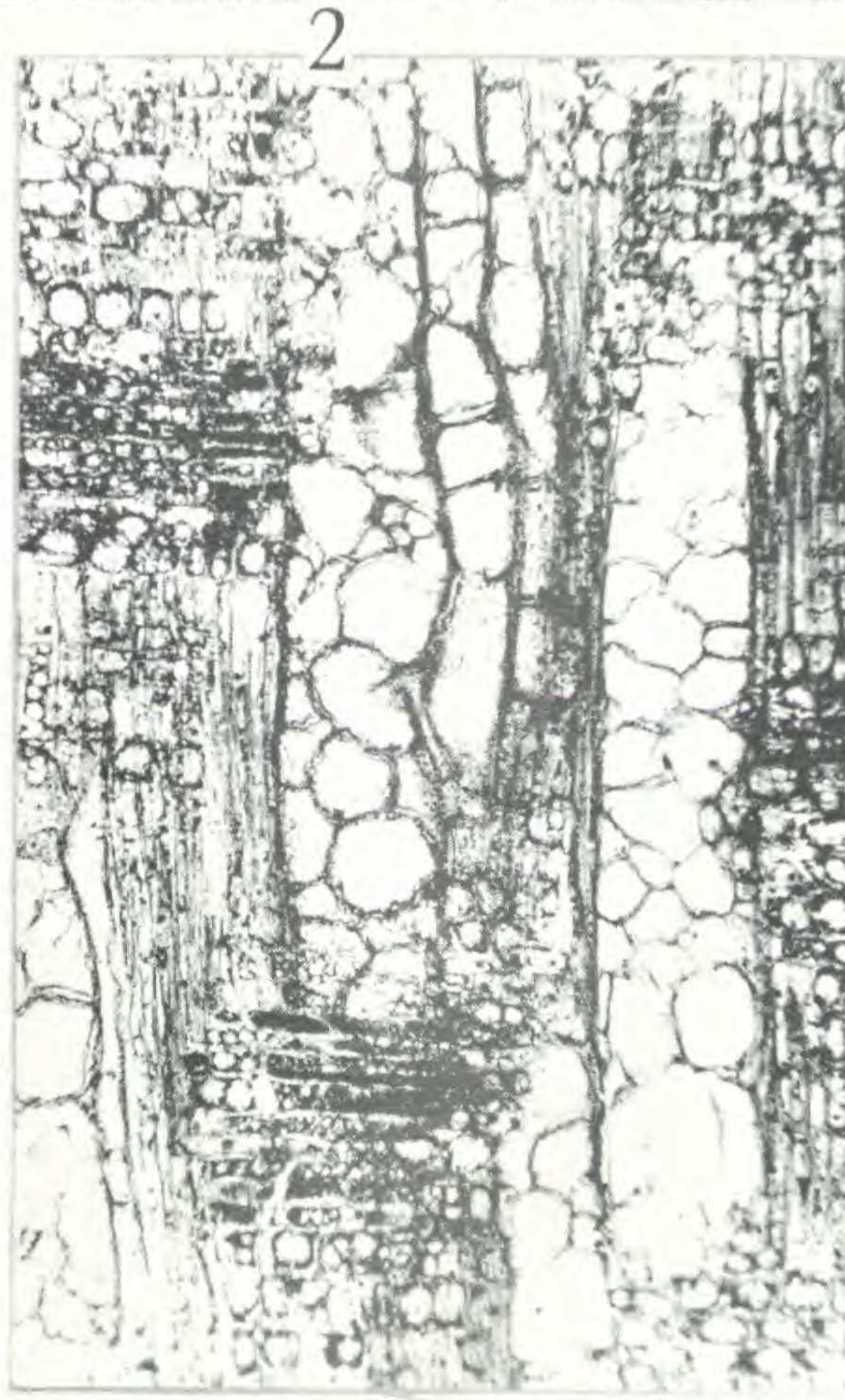

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SPACKMAN—PARAPHYLLANTHOXYLON IDAHOENSE

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SPACKMAN—PARAPHYLLANTHOXYLON IDAHOENSE

Explanation of Plate

PLATE 2

Paraphyllanthoxylon idahoense

Fig. 5. Tangential section showing septate fibers and the details of the multiseriate rays. From slide No. 1483, × 150.

Fig. 6. Tangential section showing the details of the characteristic vessel type. From slide No. 1483, × 150.

Fig. 7. Transverse section showing the patch of radially narrow fibers which was at first thought to be part of a growth ring. From slide No. 1482, × 150.